

THE SUBGENUS *Ochlerotatus* IN THE AUSTRALIAN REGION
(DIPT.: CULICIDAE). IV.

REVIEW OF SPECIES OF THE FLAVIFRONS SECTION.

By N. V. DOBROTWORSKY, Department of Zoology, University of Melbourne.*

(Three Text-figures.)

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Synopsis.

Males and larvae of *Aedes clelandi* (Taylor) and *Aedes purpuriventris* Edwards and larvae of *Aedes flavifrons* (Skuse) are described for the first time; the pupae of these species are figured. An account is given of their biology and distribution. New records of distribution of *Aedes calcariae* Marks are reported.

INTRODUCTION.

The Flavifrons Section of the subgenus *Ochlerotatus* was established by Marks (1957) to accommodate four southern species: *flavifrons*, *purpuriventris*, *clelandi* and *calcariae*. Up to this time *purpuriventris* and *clelandi* had been known only from the females and their relationships to other species were obscure. Thus Edwards (1926) expressed the opinion that *purpuriventris* was closely allied to *burpengaryensis* (Theobald) and was possibly conspecific with *nigrithorax* (Macquart).

In an earlier paper (Edwards, 1924) he had supposed that *clelandi* was close to *nivalis* Edwards, but Mackerras thought that it was a variant of *burpengaryensis*. The confusion was resolved by the discovery of the males of these two species: the recognition of the Flavifrons Section by Marks (1957) was based on similarity of the male terminalia. The structure of the terminalia suggests that the Flavifrons Section is closer to the Burpengaryensis Section than to any others of the sections.

Three members of the Section, *flavifrons*, *purpuriventris* and *calcariae*, are bush mosquitoes which, in Victoria, are found in the eastern and southern parts of the State and on the Dividing Range, though not at higher altitudes. Of the three, *flavifrons* is by far the most common species; *calcariae* and *purpuriventris* have a discontinuous distribution determined by their restricted choice of breeding sites. *Aedes clelandi* is a coastal species; it has been recorded from only two localities in Victoria, but has been found in many localities in South Australia and in the south-western part of Western Australia and Flinders Islands. *Aedes flavifrons* is distributed in New South Wales, Victoria, South Australia, Bass Strait islands and Tasmania, *Aë. purpuriventris* in Victoria, South Australia and Tasmania. *Aë. calcariae* has been recently fully described by Marks (1957), so the present paper will deal with the remaining three species of the section; full descriptions of them are given.

AÈDES FLAVIFRONS (Skuse).

Culex flavifrons Skuse, 1889, PROC. LINN. SOC. N.S.W., 3: 1735. *Culicada vandema* Strickland, 1911, *Entomologist*, 44: 202. *Culicada vandema* var. *variegatans*, *ibid.*: 204. *Culicada flavifrons* Taylor, 1914, PROC. LINN. SOC. N.S.W., 38: 751. *Aedes flavifrons* Edwards, *Bull. ent. Res.*, 14: 374.

Distinctive Characters. *Adult:* Femora and tibiae mottled; all tarsi banded; hind tarsi with basal bands. Wings mottled with creamy scales only slightly broader than dark ones; membrane with dark blotch in middle. Tergites unbanded. Male terminalia: similar to *Aë. calcariae*, but coxite tergally has only a few fine setae along inner aspect

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and lacks group of long setae near base. Harpago with strong preapical seta as in *calcariae*. Larva: Head seta 5, 3-4-branched; 6, single. Lateral comb of 35-53 coarsely fringed scales. Siphon index 3.0-3.6. Seta 1 of segment VIII, 4-5-branched.

Description of Adult.

Male. Head: Vertex clothed with curved pale golden scales, and darker forked upright ones. Proboscis mottled. Palps longer than proboscis, with patches of white scales at base of segments 4 and 5. Thorax: Integument reddish-brown. Scutum uniformly clothed with pale golden scales, with some admixture of black scales in fossa. Scutellum with pale narrow curved scales and strong black border bristles. Anterior pronotum with dark scales, some pale elongate ones and bristles. Posterior pronotum with small patch of broad pale scales below, elongate black scales in middle and narrow pale scales above. Pleura with patches of broad pale scales. Lower mesepimeral bristles absent. Knob of halteres dark with pale scales. Legs: Femora and tibiae violet black, mottled with pale scales. Tarsi (Fig. 1, *d, e, f*) of fore and mid legs with 2-3 white basal bands, hind tarsi with 5 bands. Fore tarsal claws unequal, anterior claw with two teeth, posterior with one; mid claws unequal, anterior claw long, simple, posterior small, toothed; hind claws small equal, simple. Wing length: 4.1-4.9 mm. Membrane with dark blotch in middle. Scales of wing violet-black with scattered creamy scales, only slightly broader than the dark ones. Abdomen: Tergites and sternites violet-black; tergites with white basal bands, sternites with large lateral patches of white scales. Terminalia (Fig. 1, *a, b, c*): Coxite scaled with violet-black scales sternally and laterally. Sternal aspect of coxite with dense, long yellowish setae mesially on distal half. Tergally coxite bears sparse fine setae along its inner aspect; laterally and apically with long, strong setae. Apical lobe of coxite bears several fine short setae and some stronger, longer ones. Basal lobe rounded plate with numerous setae, including 2-3 longer ones arising on tergal side of lobe. Style slightly more than half length of coxite, curved, swollen about mid length; apical third slender with 2 fine setae; appendage one-quarter length of style. Harpago stout, curved, with one strong, long preapical seta; appendage almost as long as harpago, fimbriated and with curved tip. Paraproct with one tooth. Lobes of the IXth tergite with 3-6 strong setae.

Female. Females differ from males as follows: Palps with black and ochreous scales about one-fifth length of proboscis. Mesepimeron with 2-5 lower bristles; rarely they are absent. Fore and mid tarsal claws toothed, hind simple, equal (Fig. 1, *g, h*). Wing length: 3.7-5.1 mm. Cell R_2 about twice length of stem. Tergites unbanded; VIth with admixture of ochreous scales, VIIth predominantly ochreous. Sternites mottled with ochreous and violet-black scales; white lateral basal spots on all segments.

Variation. *Aë. flavifrons* is a very variable species; this is particularly true of the female. Dark specimens have the proboscis and palps black-scaled, with only a few pale scales. The integument is dark brown. The scutum is clothed with black scales, with only a few pale golden ones which are mostly around the bare prescutellar area. The intensity of mottling of the legs and wings may be greatly reduced. On the sternites the ochreous scales may be reduced to basal lateral patches with only a few scattered ones in the black area; only sternites VI and VII have the ochreous scales dominant. There are in Victoria intermediates between the typical form and the dark one, which are similar to var. *variegatans* described by Strickland (1911) from Tasmania; the fossa, of these intermediates, is clothed entirely with black scales to form distinct black lateral patches on the light-coloured scutum. In some specimens the tergites are more or less mottled with ochreous scales.

Pupa. Details shown in Figure 1, *i, j*.

Larva (Fig. 1, *k, l*). Head, siphon and saddle light brown. Head: Head about two-thirds as long as broad. Antennae about half length of head, with scattered spicules; seta 1 arising at about two-thirds length from base, 3-5-branched. Head seta 4, tiny, 2-4-branched; 5, 3-4-branched; 6, single; 7, 8-10-branched; 8 and 9, 2-branched. Mentum with 13-14 lateral teeth on each side. Thorax: Prothoracic setae: Seta 3, 2-branched or single; 7, 2-3-branched; 1, 2, 4, 5 and 6, single. Abdomen: VIIIth segment: Lateral

comb patch of 35-53 coarsely fringed scales. Seta 1, 4-5-branched; 2 and 4, single; 3, 8-10-branched; 5, 6-7-branched. Siphon slightly tapering towards apex, index 3.0-3.6. Pecten of 15-18 spines. Seta 1, 5-6-branched, arising halfway along siphon. Anal



Fig. 1.—*Aedes flavifrons* (Skuse). *a-c*, ♂ terminalia: *a*, left coxite sternal aspect, right tergal aspect; *b*, basal lobe; *c*, harpago; *d-f*, ♂ tarsal claws: *d*, fore; *e*, mid; *f*, hind; *g-h*, ♀ tarsal claws: *g*, hind; *h*, fore and mid; *i-j*, pupa: *i*, cephalothorax and metanotum; *j*, abdomen; *k-l*, larva: *k*, prothoracic setae 1-3; *l*, head, mentum and terminal segments.

segment: Saddle covering dorsal two-thirds of segment; a small separate sclerotized plate lies near proximal angle of saddle. Setae 1 and 3, single; 2, 7-8-branched; 4 (ventral brush) of 16 tufts, usually 3 of them precratal. Anal papillae pointed, about one-third length of saddle.

Biology. *Aë. flavifrons* is one of the most common spring mosquitoes in Victoria. It breeds in ground pools, up to two feet in depth, containing leaves and twigs, and usually without vegetation. The pools may be exposed to the sun for a part of the day or completely shaded; pits, sometimes 2-3 feet deep, at the base of uprooted trees are favoured breeding sites.

In Victoria, *flavifrons* is confined to woodland at low altitudes; it has not been collected above 2,000-3,000 feet.

Larvae have been found in association with those of *Aë. queenslandis* (Strickland), *Aë. calcariae* Marks, *Aë. purpuriventris* Edwards and *Theobaldia inconspicua* Lee.

Biting Habits. It is a day biting mosquito, attracted to man; it remains active in the shade during the day even in the summer.

Distribution. Specimens have been examined from the following localities: NEW SOUTH WALES: Colo Vale (H. Blatch); VICTORIA: Cabbage Tree Creek, Combienbara, Orbst, Cranbourne, Nowa Nowa, Wilson's Promontory, Lower Tarwin, Maroondah, Yellingbo, Marysville, Ringwood, Kilmore, Ararat, Grampians, Lorne, Cape Otway, Lyonville, Carpendeit, Homerton, Milltown (N. V. Dobrotorsky). SOUTH AUSTRALIA: Robe, Lake Bonney, Narraburra, Millicent (E. W. Lines). FLINDERS ISLAND: Lady Barron (F. N. Ratcliffe), Razorback (J. H. Callaby and D. L. McIntosh). It also has been reported from Tasmania by Strickland (1911) and Lee (1948), but has not been collected in Western Australia.

AËDES PURPURIVENTRIS Edwards.

Aedes purpuriventris Edwards, 1926, *Bull. ent. Res.*, 17: 113.

Distinctive Characters. *Adult:* Posterior pronotum with broad scales below, narrow curved scales above. Wings unmottled. Femora and tibiae unmottled; hind femora dark on apical quarter or half anteriorly and posteriorly. Tarsi unbanded. Post-spiracular area with patch of broad scales. Tergites unbanded with small basal lateral patches of white scales. Typical specimens can be easily recognized by purple sternites. Male terminalia: Tergally coxite bears numerous short fine setae along inner aspect; setae on apical lobe longer and stronger than in related species. Harpago without pre-apical seta, but with 4-5 short setae on basal half. *Larva:* Antennae long, thin, curved, almost as long as head. Head seta 5, 2-4-branched; 6, 4-6-branched, plumose. Pecten of close-set spines paler towards tip. Lateral comb patch of 28-35 coarse fringed scales. Siphon short; index 2.3-3.0.

Description of Adult.

Male. Head: Curved and forked scales on vertex pale. Proboscis and palps purplish-black. Palps slightly shorter than proboscis without labella. Thorax: Integument dark brown. Scutum uniformly clothed with brown scales, becoming pale round front margin and a round bare prescutellar area; scutellum pale-scaled. Anterior pronotum with broad flat and narrow curved pale scales. Posterior pronotum with broad pale scales below, narrow dark scales above. Pleura with patches of broad white scales. Lower mesepimeral bristles absent. Legs purplish-black; fore and mid femora white beneath. Hind femora dark on apical quarter or half anteriorly and posteriorly. All claws (Fig. 2, *d, e, f*) simple except anterior one of fore legs, posterior also may be toothed. Wing membrane with faint blotch in middle. Wing length: 3.9-5.0 mm. Abdomen purplish-black-scaled, with basal lateral patches of white scales on tergites. Terminalia (Fig. 2, *a, b, c*): Coxite with purplish-black scales sternally and laterally and several strong setae. Some long yellowish setae mesially on sternal aspect, particularly on distal half. Tergally coxite bears numerous fine small setae along its inner aspect, long strong setae laterally. Apical lobe bears several short, and a few longer, setae. Basal lobe rounded plate with numerous setae. Style about half length of coxite, curved and swollen for about half length; apical third slender with 2 fine setae; appendage about one-fifth of length of style. Harpago stout curved, with 2-3 long setae and numerous fine ones on basal half; appendage as long as harpago, fimbriated and with curved tip. Lobes of IXth tergite with 3-5 strong setae.

Female. Female differs from male as follows: Palps about one-fifth length of proboscis. Mesepimeron usually with one strong dark lower bristle, and one small paler; sometimes three bristles or none. All claws equal simple or toothed (Fig. 2, *g*). Wing length: 4.4–5.2 mm. Cell R_2 about 2.4 times its stem. Blotch on wing membrane more conspicuous. Abdomen: First segment with white scales, sixth sternite mottled, seventh ochreous, all others purplish scaled.

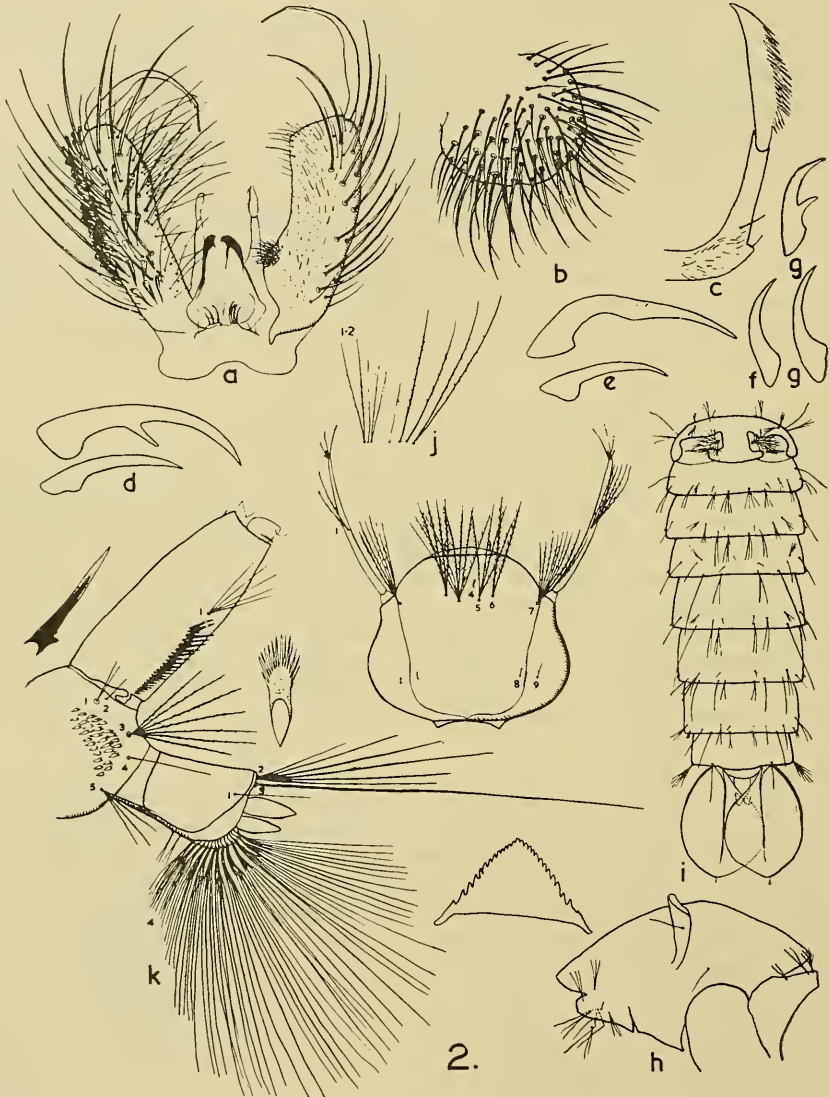


Fig. 2.—*Aedes purpuriventris* Edwards. *a-c*, ♂ terminalia: *a*, left coxite sternal aspect, right tergal aspect; *b*, basal lobe; *c*, harpago; *d-f*, ♂ tarsal claws: *d*, fore; *e*, mid; *f*, hind; *g*, ♀ tarsal claw; *h-i*, pupa: *h*, cephalothorax and metanotum; *i*, abdomen; *j-k*, larva: *j*, prothoracic seta; *k*, head, mentum and terminal segments.

Variation. *Aë. purpuriventris* collected at Lorne, Victoria, were fairly uniform, but those from Robe, S.A., show a few variations: females often have the second sternite pale-scaled and segments 6 and 7 of abdomen purple-black-scaled. A great deal of variation is found in specimens from Lyonville, Victoria. Some have lighter integument

and dark goldish scales on scutum, others have large curved pale scales, instead of broad ones on the lower part of the posterior pronotum. Tergite 5, mottled; 6 and 7 may be ochreous-scaled. Sternites may be ochreous with more or less black mottling. Tarsal claws of all legs toothed or simple; there are specimens which have both types of claws. In males there may be narrow basal bands on tergites.

Pupa. Details shown in Figure 2, *h, i*.

Larva. Head, siphon and saddle light brown. Head about six-sevenths as long as broad. Antennae long, thin, curved, slightly shorter than length of head. Seta 1 arising near mid-length, 2-5-branched. Head seta 4, 2-3-branched; 5, 4-6-branched; 6, 2-4-branched; 7, 6-11-branched; 8 and 9, 2-branched. Thorax: Prothoracic setae: 1 and 3, 1-2-branched; 2, 4, 5 and 6, single; 7, 2-branched. Abdomen: VIIIth segment: Lateral comb patch of 28-35 coarsely fringed scales. Seta 1, 3-4-branched; 2, single or 2-branched; 3, 7-8-branched; 4, single; 5, 3-5-branched. Siphon short with index 2.3-3.0. Pecten of 18-23 close-set dark spines distinctly paler towards tip and with one large stout, and 1-3 small, denticles at base. Seta 1, 4-6-branched arising about mid-length of siphon. Anal segment: Saddle almost complete ring; small separate elongate sclerotized plate at lower proximal angle of saddle. Seta 1 and 3 single; 2, 6-8-branched; 4 (ventral brush) of 16-17 tufts, 2-3 of which are precratal. Anal papillae equal, pointed, about half length of saddle; lower pair shorter than upper one.

Biology. *Aë. purpuriventris* is a spring species. It breeds in shaded ground pools and shows a preference for pits 2-3 feet deep; larvae are also commonly found in pools under uprooted trees. In South Australia larvae have been found breeding in flooded rabbit burrows. Adults have not been collected later than the end of January.

Larvae have been found in association with those of *Aë. queenslandis*, *Aë. calcariae*, *Aë. flavifrons* and *T. inconspicua*.

Biting Habits. During the spring and early summer it is a day biting mosquito, but on hot days in December or January it bites only after sunset. It does not bite man as readily as does *Aë. flavifrons*.

Distribution. Specimens have been examined from the following localities: VICTORIA: Baxter, Maroondah, Ballan, Lyonville, Lorne, Cape Otway (N. V. Dobrotworsky); Maryvale (G. W. Douglas). SOUTH AUSTRALIA: Robe, Shellbank, El Cantara, L. Eliza (E. W. Lines). It also has been recorded in Tasmania (Edwards, 1926); it has not been recorded from New South Wales or Western Australia.

AËDES CLELANDI (Taylor).

Culicada clelandi Taylor, 1914, *Trans. ent. Soc. Lond.*, 1913: 690. *Aëdes clelandi* Edwards, 1924, *Bull. ent. Res.*, 14: 379.

Distinctive Characters. *Adult:* Posterior pronotum with narrow curved scales only. Post-spiracular area mostly with narrow curved scales. Wings unmottled. Femora and tibiae unmottled; hind femora dark on apical quarter or half anteriorly. Tarsal segments with some pale scales at base. Tergites usually with basal bands. Male terminalia: Apical lobe of coxite with small setae only. Harpago with large thumb near base. *Larva:* Head seta 5, 2-branched; 6, single. Siphon short with index 2.0-2.5. Lateral comb patch of 19-21 fringed scales with central tooth twice as long as nearest one. Saddle complete ring. Ventral brush without precratal tufts.

Description of Adult.

Male. Head: Vertex clothed with pale curved, and brown upright, scales. Proboscis and palps black-scaled. Palps longer than proboscis. Thorax: Integument reddish-brown. Scutum clothed with golden scales and some scattered black ones. Scutellum with narrow pale scales. Anterior pronotum with narrow pale scales. Posterior pronotum with narrow curved scales pale below, black above. Pleura with patches of broad flat scales, except scales on post-spiracular area which has patch of narrow and only a few elongate scales. Lower mesepimeral bristles usually absent, rarely 1-2 present. Knob of haltere dark with pale scales. Legs: Fore and mid femora, and tibiae

dark-scaled above, pale beneath. Hind femora dark on apical quarter or half anteriorly, a few paler scales on dark distal part of femur. Hind tibiae and first tarsal segment of all legs with pale scales beneath and some on black dorsal side. Tarsi unbanded, but



Fig. 3.—*Aedes clelandi* (Taylor). *a-b*, ♂ terminalia: *a*, left coxite sternal aspect, right tergal aspect; *b*, harpago; *c-e*, ♂ tarsal claws: *c*, fore; *d*, mid; *e*, hind; *f-h*, ♀ tarsal claws: *f*, fore; *g*, mid; *h*, hind; *i-j*, pupa: *i*, cephalothorax and metanotum; *j*, abdomen; *k-l*, larva: *k*, prothoracic setae; *l*, head, mentum and terminal segments.

with some pale scales at base of first 2-3 segments. Claws (Fig. 3, *c*, *d*, *e*) of fore and mid tarsi toothed, of hind tarsi simple. Wing length: 3.5-4.7 mm. Tergites black-scaled with basal bands. Sternites black-scaled with white lateral basal patches. Terminalia (Fig. 3, *a*, *b*): Coxite dark-scaled sternally and laterally, with several strong

setae. Tergal aspect of coxite with small setae along its inner side and long strong setae laterally and apically. Sternally coxite has long goldish setae mesially on apical half. Apical lobe with about 20 short fine setae. Basal lobe rounded plate with numerous moderately long setae. Style about half length of coxite, curved and swollen at about mid length; apical third slender. Appendage about one-quarter length of style. Harpago stout, curved, with prominent thumb near base; basal third with numerous fine setae and 3-4 larger ones; appendage almost as long as harpago, fimbriated; tip blunt. Paraproct with single tooth. Lobes of IXth tergite with 3-5 strong setae.

Female. Female differs from male as follows: Palps about one-fifth length of proboscis. 1-3 strong, pale lower mesepimeral bristles. Claws (Fig. 3, *f, g, h*) of fore and mid tarsi equal toothed, of hind tarsi simple. Wing length: 3.4-4.9 mm. Cell R_2 about 2.7 times its stem. Abdomen: Tergites violet-black-scaled, with basal creamy-white bands which may be reduced to a few pale scales and lateral patches; seventh tergite may be mottled. Sternites ochreous-scaled; black scales may form central patch, may be scattered, giving a mottled appearance, or may be few in number.

Pupa. Details shown in Figure 3, *i, j*.

Larva (Fig. 3, *k, l*). Head, siphon and saddle light brown. Head about three-quarters as long as broad. Antenna short and stout, less than half length of head; seta 1 arising near mid-length of antenna, 4-5-branched. Head seta 4, 2-3-branched; 5, usually 3-branched; 6, single; 7, 6-8-branched; 8, 1-2-branched; 9, 2-branched. Mentum with 14-15 small lateral teeth. Thorax: Setae 1-6 single; 7, 2-3-branched. Abdomen: VIIIth segment: Lateral comb of 19-21 scales fringed at base, and with central tooth twice as long as nearest lateral one. Seta 1, 3-branched; 2 and 4, single; 3, 7-8-branched; 4, 3-4-branched. Siphon short, with index 2.0-2.5. Pecten of 19-21 spines, with one large, stout denticle and 1-3 small ones. Seta 1, 5-branched, arising about mid length of siphon. Anal segment: Saddle complete ring. Separate small, elongate sclerotized plate ventro-laterally near saddle. Seta 1 and 3, single; 2, 6-7-branched; 4 (ventral brush), of 16 tufts. Anal papillae short, pointed, upper pair less than half length of saddle, lower pair shorter.

Biology. *Aë. clelandi* is a spring species. Larvae have not been found in the field in Victoria, but presumably the breeding sites are similar to those recorded elsewhere. In Western Australia *clelandi* breeds in freshwater pools with or without vegetation (Britten, 1955); in South Australia larvae have been found with those of *Aë. calcariae* in flooded rabbit burrows where the water may be two feet below ground level and heavily contaminated with rabbit faeces (Marks, 1957). Adults have been collected as early as July (Britten, 1955), but in Victoria they are most common during September-November. On Phillip Island they occur in numbers in the tea-tree scrub adjoining the shore.

Biting Habits. It is a day biting species which attacks man.

Distribution. Specimens have been examined from the following localities: VICTORIA: Phillip Island, Lower Tarwin (N. V. Dobrotorsky). SOUTH AUSTRALIA: Calcaria, Robe, Cantara, L. Eliza (E. W. Lines); Warren R. (W. D. Dodd). WESTERN AUSTRALIA: Cowdale (F. N. Ratcliffe); Janangara, Emu Pk., Albany, Forestdale, Bullsbrook, Canning Bridge, Darkan, Dale River (McIntosh); Lancilia, Albany, Denmark, Karagullen (E. J. Britten). FLINDERS ISLAND: Lady Barron (F. N. Ratcliffe); Vinegar Hill (J. H. Calaby). *Aë. clelandi* has not been recorded in New South Wales or Tasmania.

AËDES CALCARIAE Marks.

Aëdes calcariae Marks, 1957, *Pap. Dep. Ent. Univ. Qd.*, 1 (5): 74.

The additional records are: VICTORIA: Yellingbo, Sylvan, Grampians, Gorae West, Homerton.

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